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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/562,970

12/29/2005

Sozaburo Ohashi

126491

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7590

11/01/2007

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EXAMINER

RUTHKOSKY, MARK

ART UNIT

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1795

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DELIVERY MODE

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/562,970	Applicant(s) OHASHI, SOZABURO	
	Examiner Mark Ruthkosky	Art Unit 1745	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 11 May 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-9 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☐ Claim(s) 1-9 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTQ/SB/08)
Paper No(s)/Mail Date <u>5/11/2007</u> ; <u>3/5/07</u> ; <u>10/6/06</u> | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Information Disclosure Statement

The information disclosure statement filed 5/11/2007 has been placed in the application file, and the information referred to therein has been considered as to the merits.

Claim Rejections - 35 USC § 112

The rejection of claims 2-4 under 35 U.S.C. 112, second paragraph, has been overcome by applicant's amendment to the claims.

Claim Rejections - 35 USC § 102

The rejection of claims 1-2 under 35 U.S.C. 102(b) as being anticipated by Imahashi et al (US 5,350,643) has been overcome by applicant's amendment to the claims.

Claim 5 is rejected under 35 U.S.C. 102(b) as being anticipated by Imahashi et al (US 5,350,643.)

The instant claims are to a fuel cell having at least a membrane electrode assembly comprising an electrolyte membrane, a hydrogen electrode-side catalyst layer formed on one side thereof, and an air electrode-side catalyst layer formed on the other side thereof, in which a porosity of the hydrogen electrode-side catalyst layer is made to be lower than a porosity of the air electrode-side catalyst layer, wherein the hydrogen electrode-side catalyst layer contains an additive having a particle diameter sized to fill a plurality of voids in a carbon carrier included in

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the hydrogen electrode-side catalyst layer so as to lower the porosity of the hydrogen electrode-side catalyst layer.

Imahashi et al (US 5,350,643) teaches a fuel cell having at least a membrane electrode assembly comprising an electrolyte membrane, a hydrogen electrode-side catalyst layer formed on one side thereof, and an air electrode-side catalyst layer formed on the other side thereof, in which the porosity of the hydrogen electrode-side catalyst layer is made to be lower than that of the air electrode-side catalyst layer (claims 1-11, col. 4, line 61 to col. 6, line 54, example 1.) The electrodes include ion-exchange materials to transfer charged ions and water, catalyst for catalyzing the fuel cell reactions that produce electricity, binder for holding the electrode together and a conductive carbon carrier for transferring the electricity. The reference establishes that the conductive carbon carrier increases electrical conductivity, but reduces ionic conductivity in the electrode, while the ion exchange resin increases ionic conductivity, but reduces electrical conductivity (see cols. 5-6 and examples 1-3.) With regard to claim 5, example three discloses using materials having smaller particle sizes for the hydrogen catalyst electrode relative to the oxygen catalyst electrode in order to prepare a hydrogen catalyst electrode having a lower porosity (also see col. 5, lines 1-12.) The particle sizes are adjusted to fill voids in the carbon carrier paper and control the porosity of the electrode (col. 8, lines 50-45.) Thus, the claim is anticipated.

Claim 8 is rejected under 35 U.S.C. 102(b) as being anticipated by Imahashi et al (US 5,350,643.)

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The instant claims are to a fuel cell having at least a membrane electrode assembly comprising an electrolyte membrane, a sprayed hydrogen electrode-side catalyst layer formed on one side thereof, and a non-sprayed air electrode-side catalyst layer formed on the other side thereof, in which a porosity of the hydrogen electrode-side catalyst layer is made to be lower than a porosity that of the air electrode-side catalyst layer wherein the hydrogen electrode-side catalyst layer is formed by spraying a catalyst ink and the air electrode-side catalyst layer is formed by a transfer method so that the porosity of the hydrogen electrode-side catalyst layer is made to be lower than that of the air electrode-side catalyst layer.

Imahashi et al (US 5,350,643) teaches a fuel cell having at least a membrane electrode assembly comprising an electrolyte membrane, a hydrogen electrode-side catalyst layer formed on one side thereof, and an air electrode-side catalyst layer formed on the other side thereof, in which the porosity of the hydrogen electrode-side catalyst layer is made to be lower than that of the air electrode-side catalyst layer (claims 1-11, col. 4, line 61 to col. 6, line 54, example 1.) The electrodes include ion-exchange materials to transfer charged ions and water, catalyst for catalyzing the fuel cell reactions that produce electricity, binder for holding the electrode together and a conductive carbon carrier for transferring the electricity. The reference establishes that the conductive carbon carrier increases electrical conductivity, but reduces ionic conductivity in the electrode, while the ion exchange resin increases ionic conductivity, but reduces electrical conductivity (see cols. 5-6 and examples 1-3.) With regard to claim 8, the reference does not teach the method of spraying the catalyst, however, MPEP 2113 states, "Even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its

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method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process.” The porosity of the hydrogen electrode-side catalyst layer is lower than that of the air electrode-side catalyst layer. Thus, the claim is anticipated.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-4, 7, and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Imahashi et al (US 5,350,643),

The instant claims are to a fuel cell having at least a membrane electrode assembly comprising an electrolyte membrane, a hydrogen electrode-side catalyst layer formed on one side thereof, and an air electrode-side catalyst layer formed on the other side thereof, in which the porosity of the hydrogen electrode-side catalyst layer is made to be lower than a porosity of the air electrode-side catalyst layer and a volume of pore space of the hydrogen electrode-side catalyst layer has a range of 1.0% to 3.0% of a total volume of the catalyst layer.

Imahashi et al (US 5,350,643) teaches a fuel cell having at least a membrane electrode assembly comprising an electrolyte membrane, a hydrogen electrode-side catalyst layer formed on one side thereof, and an air electrode-side catalyst layer formed on the other side thereof, in which the porosity of the hydrogen electrode-side catalyst layer is made to be lower than that of

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the air electrode-side catalyst layer (claims 1-11, col. 4, line 61 to col. 6, line 54, example 1.)

The electrodes include ion-exchange materials to transfer charged ions and water, catalyst for catalyzing the fuel cell reactions that produce electricity, binder for holding the electrode together and a conductive carbon carrier for transferring the electricity. The reference establishes that the conductive carbon carrier increases electrical conductivity, but reduces ionic conductivity in the electrode, while the ion exchange resin increases ionic conductivity, but reduces electrical conductivity (see cols. 5-6 and examples 1-3.) The amount of ion-exchange resin (taught as a proton conductor in the reference) is greater in the hydrogen electrode than in the oxygen electrode (col. 7, lines 1-15.)

The reference does not teach the volume of pore space of the hydrogen electrode-side catalyst layer accounts for 1.0% to 3.0% of the total volume of the catalyst layer and the volume of pore space of the air electrode-side catalyst layer accounts for 3% to 30% of the total volume of the catalyst layer. The reference teaches that the pore space of the hydrogen electrode is lower than that of the oxygen electrode (see col. 4, lines 30-40 and col. 6.) It would have been obvious to one of ordinary skill in the art at the time the invention was made to adjust the volume of pore space of the hydrogen electrode-side catalyst layer to account for 1.0% to 3.0% of the total volume of the catalyst layer and the volume of pore space of the air electrode-side catalyst layer to account for 3% to 30% of the total volume of the catalyst layer, in order to adjust the flow of the fuel and oxidant gasses to the electrodes. The prior art teaches the advantages and disadvantages of increasing/decreasing the pore space in the electrode as noted in col. 6, lines 30-55.) When porosity is too high, the electrical resistance of the electrode increases. When porosity is too low, the diffusion of the reactant gas is insufficient. One skilled in the art would

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recognize that if a load that requires a low amount of power, less fuel is required by the fuel cell. The reference also teaches that the hydrogen diffusion into and through the electrode is high due to the smaller size of hydrogen (col. 6, lines 6-54.) Relatively lower porosity is therefore sufficient in the hydrogen electrode. The diffusion and reactivity of oxygen is relatively low so increased pore size allows for improved diffusion and reactivity. Thus, the prior art recognizes the advantages of lower porosity in the hydrogen electrode and higher relative porosity in the oxygen electrode including good diffusion/reactivity, and increased conductivity due to more conductive material. The same reasoning applies for adjusting the porosity of the oxygen electrode. From this, the skilled artisan has the knowledge to adjust the relative amount of porosity in order to obtain the desired results such as hydrogen and oxygen reactivity at the catalyst electrodes, electron conductivity through the fuel cell, ionic transfer between the electrodes and the electrolyte, and water management of the electrode/electrolyte assembly.

With regard to claim 3, the reference does not teach the weight ratio of ion-exchange resin to carbon carriers of the hydrogen electrode-side catalyst layer is greater than or equal to 1.5:1 and less than 3.0:1 and the weight ratio of ion-exchange resin to carbon carriers of the air electrode-side catalyst layer is greater than or equal to 0.4:1 and less than 1.5:1. The reference does not provide a specific weight for the carbon carriers. The reference does state in example 1 that the amount of ion-exchange material is 30 wt. % and the amount of PTFE is 30% in the hydrogen electrode, while the amount of ion-exchange material is 20 wt. % and the amount of PTFE is 20% in the oxygen electrode. It is clear that the ratio is higher in the hydrogen electrode than in the air electrode. It would have been obvious to one of ordinary skill in the art at the time the invention was made to use a weight ratio of ion-exchange resin to carbon carriers of the

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hydrogen electrode-side catalyst layer is greater than or equal to 1.5:1 and less than 3.0:1 and the weight ratio of ion-exchange resin to carbon carriers of the air electrode-side catalyst layer is greater than or equal to 0.4:1 and less than 1.5:1 in order to give an electrode having an increased porosity on the oxygen electrode. The reference teaches that the hydrogen diffusion into and through the electrode is high due to the smaller size of hydrogen (col. 6, lines 6-54) that the diffusion and reactivity of oxygen is relatively low due to the larger relative size of oxygen, and that increasing the pore size allows for improved diffusion and reactivity. Further, water management in the electrode is taught such that increasing the amount of the ion-conductor or porosity will improve the flow of water from the oxygen electrode to the electrolyte membrane (see col. 6, lines 6-54 and col. 5, lines 9-50.) The invention prevents water from clogging the pores. Thus, the prior art recognizes the advantages of increasing the amount of ion-exchange resin improving water flow and lowering porosity, as well as the limitations of increased porosity (such as increased resistivity due to lesser amounts of conductive material.) From this, the skilled artisan have the knowledge to adjust the relative amount of each material in order to obtain the desired results.

Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Imahashi et al (US 5,350,643.)

The teachings of Imahashi et al (US 5,350,643) have been presented. With regard to claim 6, the reference does not teach the average particle diameter of the additive is less than or equal to 0.3 μm . Example three discloses using materials having smaller particle sizes in the hydrogen catalyst electrode relative to the oxygen catalyst electrode in order to prepare a

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hydrogen catalyst electrode having a relatively lower porosity. The reference also teaches that adjustment of porosity can be achieved by changing particle sizes of the electrode material and the amount of the material (see col. 5, lines 1-12.) It would have been obvious to one of ordinary skill in the art at the time the invention was made to use a particle size having average particle diameter of less than or equal to 0.3 μm in order to reduce the porosity of the hydrogen electrode so the flow of hydrogen is sufficient for reactivity at the negative electrode and the electrical conductivity of the electrode is improved due to greater amounts of carbon carrier. The prior art recognizes the advantages of smaller sized materials in the hydrogen electrode for decreasing porosity, the design of gas diffusion and reactivity, and increased conductivity due to more conductive material. From this, the skilled artisan has the knowledge to adjust the relative material size in order to obtain the desired results. The artisan would have found the claimed invention to be obvious in light of the teachings of the references. MPEP 2113 states, "Even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process." As the porosity of the hydrogen electrode-side catalyst layer is lower than that of the air electrode-side catalyst layer, the reference anticipates the claimed invention.

Response to Arguments

Applicant's arguments with respect to the claims have been considered but are not persuasive. The rejections have been altered to reflect the amendments to the claims.

Applicant argues that Imahashi teaches away from the claimed particular pore space volume by stating "the porosity has a proper range and according to investigation by the inventors this is preferably about 35 to 60% for the hydrogen electrode and is about 40 to 65% for the oxygen electrode." and that the incorporation of the specific pore volume space as recited in claim 1 would not be obvious from Imahashi.

This argument is not persuasive. Imahashi teaches that the porosity of the hydrogen electrode is lower than that of the oxygen electrode and the advantages and disadvantages of increasing/decreasing the pore space in the electrode. When porosity is too high, the electrical resistance of the electrode increases. When porosity is too low, the diffusion of the reactant gas is insufficient. One skilled in the art would recognize that if a load that requires a low amount of power, less fuel is required in the fuel cell. The reference also teaches that the hydrogen diffusion into and through the electrode is high due to the smaller size of hydrogen (col. 6, lines 6-54.) Relatively lower porosity is therefore sufficient in the hydrogen electrode. The diffusion and reactivity of oxygen is relatively low so increased pore size allows for improved diffusion and reactivity. Thus, the prior art recognizes the advantages of lower porosity in the hydrogen electrode and higher relative porosity in the oxygen electrode including good diffusion/reactivity, and increased conductivity due to more conductive material. From this, the skilled artisan clearly has the knowledge to adjust the relative electrode porosity in order to obtain the desired results such as hydrogen and oxygen reactivity at the catalyst electrodes, electron conductivity through the electrodes and fuel cell, ionic transfer between the electrodes and the electrolyte, and water management of the electrode/electrolyte assembly.

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Applicant further argues that because Imahashi teaches large carbon-based polymers as a substrate, Applicant respectfully submits that the Imahashi compounds are not particles "sized to fill a plurality of voids in a carbon carrier." Applicant further states that, "because these compounds function differently due to their nonionic nature and hydrophilic/hydrophobic ends and they are used for a different function (water repellency), a person skilled in the art would not be motivated by Imahashi to use a small particle that fills the voids of the carbon carrier." These arguments are not persuasive. The fact that Imahashi teaches large carbon-based polymers as a substrate in specific embodiments does not lead to the conclusion that Imahashi compounds are not particles "sized to fill a plurality of voids in a carbon carrier." Example three discloses using materials having smaller particle sizes for the hydrogen catalyst electrode relative to the oxygen catalyst electrode in order to prepare a hydrogen catalyst electrode having a lower porosity (also see col. 5, lines 1-12.) The particle sizes are adjusted to fill voids in the carbon carrier paper and control the porosity of the electrode (col. 8, lines 50-45.)

Applicant then argues that claim 8 recites that the electrolyte membrane includes a sprayed hydrogen electrode-side catalyst layer formed on one side and a non-sprayed air electrode-side catalyst layer formed on the other side and that Imahashi does not teach or suggest an electrolyte membrane having a sprayed hydrogen electrode-side catalyst layer and a non-sprayed air electrode-side catalyst layer. Applicant further argues that, "Imahashi does not teach or suggest a structural difference between the two catalyst layers. Moreover, Imahashi does not teach or suggest that different application techniques can be used to achieve this structural difference between the hydrogen and air catalyst layers." As noted in the rejection, the process of spraying the catalyst is a process limitation that does not limit the product claimed. Applicant

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has not provided any evidence that there is a structural difference between the two catalyst layers based on the claim language.

Applicant concludes arguments by stating that the features of the presently claimed invention provide unexpected results from the structural differences achieved by using a spraying method to form the hydrogen catalyst and a transfer method to form the air catalyst, as shown in Figs. 4 and 5 of the present application.

Figures 4-5 show pore volume and porosity distribution for the hydrogen and oxygen electrodes. Absent specific arguments to these graphs with regard to spraying the hydrogen electrode, the data is not unexpected and, at best, is inconclusive. The data is not commensurate in scope with the claimed invention. The conditions of each method are not fully disclosed and are not claimed. The figures merely show that the hydrogen electrode has a lower porosity than the air electrode catalyst. This feature of the porosity in each electrode is taught in the cited reference albeit by a different method, as noted in the rejection.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period

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will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Examiner Correspondence

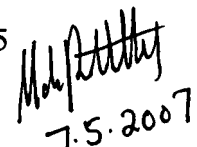
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mark Ruthkosky whose telephone number is 571-272-1291. The examiner can normally be reached on FLEX schedule (generally, Monday-Thursday from 9:00-6:30.) If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached at 571-272-1292. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free.)

Mark Ruthkosky

Primary Patent Examiner

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7.5.2007